## VI. CLAIMS

1. A computer controlled and serviced intrusive plunger fruit tester, comprising in combination:

a frame having a base supporting laterally opposed upstanding sides interconnected by a top;

a centering plate, carried by the base between the sides, having [means] an upper surface defining an inverted right circular conic indentation for centering a fruit supported thereon;

a powering train carried by the frame having a motor powering a motion translator for motion in a vertically orientated linear trajectory toward and away from the centering plate;

a circular cylindrical plunger, carried spacedly above the centering plate and in axial alignment with the conic indentation defined therein, by [a] an "S" shaped stress block depending from the motion translator for vertical motion toward and away from the centering plate responsive to motion of the motion translator, said "S" shaped stress block having upper and lower legs interconnected in opposed end portions by a body having upper and lower beam arms;

a control member carried by the frame having

first means for powering the motor,

second means for sensing motor speed,

third means for controlling motor speed,

fourth strain gauge means carried by the stress block for sensing pressure resisting plunger motion toward the centering plate said strain gauge means including at least two spacedly adjacent sensing elements carried by each of the upper and lower beam arms of the stress block body, all said sensing elements interconnected in a full bridge configuration, and

fifth means communicating with an associated computer for transmitting and receiving digital [computer] data; and

an associated computer having software means for directing control member operation and for receiving, analyzing and displaying data received from the control member.

3. The fruit tester of Claim 1 further characterized

by:

the centering plate carried in a testing chamber defined above the base and between the opposed sides with a rear shield carried by the opposed sides to enclose a rearward portion of the testing chamber and a front shield movably carried by the opposed sides to selectively enclose a forward portion of the testing chamber; [and]

a cover carried by the frame to enclose the fruit tester above the testing chamber[.]; and

switch means to stop operation of the fruit tester when the front shield is not closed against the opposed sides.

4. The fruit tester of Claim 1 further characterized by:

a stripper plate carried between the sides spacedly above the centering plate and below the stress block, said stripper plate defining an orifice for passage of the plunger therethrough but preventing passage of a fruit upwardly past the [stipper] stripper plate.

6. A computer controlled and serviced intrusive plunger type fruit tester, comprising in combination:

a frame having a base supporting laterally opposed upstanding sides having upper portions interconnected by a top;

a centering plate carried on the base and having an upper surface distal from the base defining a right circular conic indentation with apex lowermost to center a fruit supported thereon;

a testing chamber defined above the base by a semi-cylindrical rear shield extending between the sides and a semi-cylindrical front shield pivotally carried by one side and extending to the other side to allow access to the testing chamber;

a stripper plate, carried between the sides in the testing chamber spacedly above the centering plate, said stripper plate defining an orifice to allow passage of a plunger therethrough and prevent passage of a fruit upwardly above the stripper plate;

a cover enclosing the frame above the testing

chamber;

a powering train supported by the frame and having a motor carried by the top communicating through a speed regulating transmission to drive a motion translator that moves a plunger slide body toward and away from the centering plate;

an elongate circularly cylindrical plunger carried by [a] an "S" shaped stress block depending from structural interconnection with the plunger slide body, said plunger being spacedly distant from the centering plate and axially aligned with the apex of the conic indentation defined in the centering plate and said "S" shaped stress block having upper and lower legs interconnected in opposed end portions by a body having upper and lower beam arms of lesser cross sectional area than the upper and lower legs;

a control member carried by the frame and having

battery powering means,

an optoelectric encoder carried by the motor for sensing and transmitting motor speed data,

a motor controller for determining motor speed responsive to software commands generated responsively to historical motor speed data, and

a [plurality of] strain gauge[s] [spacedly] carried by the stress block <u>including at least two spacedly adjacent sensing elements carried by each of the upper and the lower beam arms of the stress block body</u> and electrically interconnected in a <u>full</u> bridge circuit to sense and transmit data indicating pressure resisting plunger motion toward the centering plate; and

an associated computer having software means for transmitting data to the control member and for receiving, analyzing, displaying and storing data received from the control member.

7. A method for determining the maturation state and condition of a fruit with a computer serviced intrusion type plunger tester, comprising the steps of:

<u>classifying a soft tissue fruit into three</u>

concentric zones consisting of a first zone extending spacedly inward from the fruit periphery, a third zone including the fruit core and a second zone bounded by the first and third zones;

mechanically moving an elongate plunger into the fruit through [a plurality of spaced] at least one data point[s within] in each of the said three zones of the fruit and determining plunger position relative to the fruit surface at [at least some] each of the data points;

determining [pressure resisting plunger penetration into] data relating to the viscoelastic properties of the fruit at [least one] each data point within the fruit;

analyzing the data relating to the viscoelastic properties of [pressure resisting plunger penetration into] the fruit at [the at least one] each data point by comparing that [pressure] data with a predetermined profile of similar [analyses] data of similar fruit of predetermined condition and maturation state to determine the condition and maturation state of the tested fruit.

8. The process of Claim 7 further including the step of:

moving the plunger into the fruit at a constant predetermined velocity <u>at at least one data point in each zone</u> and measuring the pressure resisting plunger penetration into the fruit at [at least some of] the [spaced] <u>at least one</u> data point[s] <u>in each zone</u>.

9. The process of Claim 7 [including the step of] <u>wherein the data relating to the viscoelastic properties of the fruit is determined by</u>:

maintaining the plunger in the fruit at a predetermined constant pressure at at least one [predetermined] data point <u>in each zone</u> and measuring plunger motion over a predetermined period of time at the at least one [predetermined] data point <u>in each zone</u>.

10. The process of Claim 7 [further including the steps of:] <u>wherein the data relating to the viscoelastic properties of the fruit is determined by:</u>

sequentially moving the plunger into the fruit

at predetermined constant velocity and maintaining the plunger in the fruit under predetermined constant pressure for [at least one] a predetermined period of time at at least one data point in each zone; and

determining both force resisting plunger penetration and distance of plunger motion under constant pressure at the at least [some of the spaced] one data point[s] in each zone.

11. The method of Claim 7 further including the steps of:

classifying an apple into three concentric zones comprising an R-1 zone extending from the fruit peripheral surface radially inwardly to a depth of substantially 0.320 inch, an R-2 zone extending radially inwardly from the R-1 zone to an R-3 zone and R-3 zone comprising the core area;

determining plunger position and pressure resisting plunger penetration into the fruit at at least one data point in [each] at least two of the three concentric zones[; and].

[analyzing the pressure resisting plunger penetration in each of the three zones to determine fruit condition and maturation state by comparing the pressure data in each zone to similar data obtained from fruit of the same type and of predetermined condition and maturation state to determine the condition and maturation state of the tested fruit.]

12. The method of Claim 7 further including the steps of:

classifying an apple into three concentric zones comprising an R-1 zone extending from the fruit peripheral surface radially inwardly to a depth of substantially 0.320 inch, an R-2 zone extending radially inwardly from the R-1 zone to an R-3 zone and an R-3 zone comprising the core area;

determining initial plunger position, [and] [plunger motion] moving the plunger therefrom at a predetermined constant [plunger pressure over a predetermined period of time] velocity and measuring pressure resisting plunger motion at at least one data

point in [each] at least two of the three concentric zones[; and].

[analyzing the plunger motion in each of the three zones to determine the fruit condition and maturation state by comparing the motion data to similar data obtained from fruit of the same type and of predetermined condition and maturation state.]

13. The method of Claim 7 further including the steps of:

classifying an apple into three concentric zones comprising an R-1 zone extending from the fruit peripheral surface radially inwardly to a depth of substantially 0.320 inch, an R-2 zone extending radially inwardly from the R-1 zone to an R-3 zone and an R-3 zone comprising the core area;

determining plunger position and sequentially moving the plunger into the fruit at a predetermined constant velocity to determine pressure resisting plunger penetration and maintaining the plunger in the fruit

under predetermined constant pressure for at least one predetermined period[s] of time to determine plunger penetration under constant pressure both at at least one data point in [each] at least two of the three concentric zones[; and]

[analyzing the pressure resisting plunger penetration and the plunger motion under constant load in each zone to determine fruit condition and maturation state by comparing the plunger pressure data and motion data in each zone to similar data obtained from fruit of predetermined condition and maturation state.]

14. The method of Claim [13] 7 further including the step of:

determining a quality factor comprising a numerical value representing fruit condition by combining numerical values of pressure resisting plunger penetration at a predetermined constant plunger velocity and plunger penetration over a predetermined time at a constant plunger pressure as determined in [all three] at least two concentric zones of the fruit.

15. The method of Claim [13] 14 further including the step of:

determining the quality factor by combining the numerical data in each of the [three] at least two concentric zones of the fruit by averaging the numerical data from each zone, weighting the average of the data from at least one zone and [adding] combining the resultant averages for each zone.

16. The process of Claim 7 further includes the step of:

measuring frequency dependent pressure resisting plunger penetration at constant plunger velocity over a predetermined sequence of data points in at least two of the three zones; and

analyzing the numeric values of frequency dependent pressure variations at the sequential data points through finite Fourier transformation to derive a numeric measure representing fruit maturity and condition from the frequency dependent pressure values for comparison with similar values derived from fruit of the same type and of

predetermined condition and maturation state to determine the condition and maturation state of the tested fruit.